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10/507,505

09/13/2004

Takahisa Kaňeko

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25944 7590 11/15/2007  
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EXAMINER

LEYSON, JOSEPH S

ART UNIT

PAPER NUMBER

1791

MAIL DATE

DELIVERY MODE

11/15/2007

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Interview Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	10/507,505	KANEKO ET AL.	
	<b>Examiner</b>	<b>Art Unit</b>	
	Joseph Leyson	1791	

All participants (applicant, applicant's representative, PTO personnel):

(1) Joseph Leyson.

(3) Mr. Mitsuru Hattori.

(2) Obert Chu.

(4) \_\_\_\_\_.

Date of Interview: 09 November 2007.

Type: a) ☐ Telephonic b) ☐ Video Conference  
c) ☒ Personal [copy given to: 1) ☐ applicant 2) ☒ applicant's representative]

Exhibit shown or demonstration conducted: d) ☒ Yes e) ☐ No.

If Yes, brief description: Wikipedia SiC-see attached.

Claim(s) discussed: all pending.

Identification of prior art discussed: prior art used in the rejection.

Agreement with respect to the claims f) ☐ was reached. g) ☒ was not reached. h) ☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: Discussed prior art rejections in view of Bagley and Wikipedia Sic, but no agreement was reached.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN A NON-EXTENDABLE PERIOD OF THE LONGER OF ONE MONTH OR THIRTY DAYS FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

  
Examiner's signature, if required

## Summary of Record of Interview Requirements

### Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record

A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

### Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews

#### Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

#### 37 CFR §1.2 Business to be transacted in writing.

All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted,
- 2) an identification of the claims discussed,
- 3) an identification of the specific prior art discussed,
- 4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
- 5) a brief identification of the general thrust of the principal arguments presented to the examiner,  
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
- 6) a general indication of any other pertinent matters discussed, and
- 7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

### Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

### Applicant Initiated Interview Request Form

Application No.: 10/507,505 First Named Applicant: Takahisa KANEKO  
 Examiner: J. LEYSON Art Unit: 1722 Status of Application: \_\_\_\_\_

**Tentative Participants:**

(1) Obert Chu (2) Mr. Mitsuru (Mick) Hattori  
 (3) \_\_\_\_\_ (4) \_\_\_\_\_

Proposed Date of Interview: Nov 9 Proposed Time: 3:30PM (AM/PM)

**Type of Interview Requested:**

(1) ☐ Telephonic (2) ☒ Personal (3) ☐ Video Conference

Exhibit To Be Shown or Demonstrated: ☐ YES ☐ NO

If yes, provide brief description: \_\_\_\_\_

### Issues To Be Discussed

Issues (Rej., Obj., etc)	Claims/ Fig. #s	Prior Art	Discussed	Agreed	Not Agreed
(1) <u>Rej</u>	<u>9 and 11</u>	<u>Bagley</u>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(2) _____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(3) _____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(4) _____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

☐ Continuation Sheet Attached

**Brief Description of Arguments to be Presented:**

Input material of Bagley (e.g. ceramic materials etc.) vs. Present Application (SiC) and thus, criticality of the connection area ratio; and briefly discuss AI of Bagley as a potential material for Die. Briefly address double patenting.

SiC wikipedia article for your brief review.

An interview was conducted on the above-identified application on \_\_\_\_\_

**NOTE:**

This form should be completed by applicant and submitted to the examiner in advance of the interview (see MPEP § 713.01).

This application will not be delayed from issue because of applicant's failure to submit a written record of this interview. Therefore, applicant is advised to file a statement of substance of this interview (37 CFR 1.133(b)) as soon as possible.

\_\_\_\_\_  
 (Applicant/Applicant's Representative Signature)

\_\_\_\_\_  
 (Examiner/SPE Signature)

# Silicon carbide

From Wikipedia, the free encyclopedia

**Silicon carbide** (SiC) is a ceramic compound of silicon and carbon that is manufactured on a large scale for use mainly as an abrasive but also occurs in nature as the extremely rare mineral moissanite.

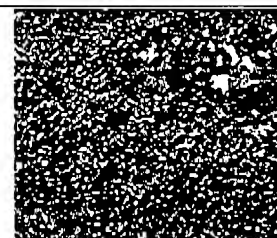
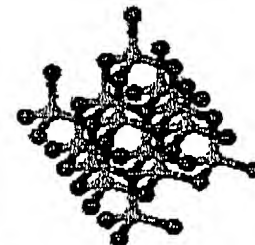
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## Production

Due to the rarity of natural moissanite, silicon carbide is typically man-made. Most often it is used as an abrasive where it is often known by the trademark **carborundum**, and more recently as a semiconductor and diamond simulant of gem quality. The simplest manufacturing process is to combine silica sand and carbon in an Acheson graphite electric resistance furnace at a high temperature, between 1600 and 2500 °C.

Silicon carbide



### Identifiers

CAS number	409-21-2 ( <a href="http://www.emolecules.com/cgi-bin/search?t=ss&amp;q=409-21-2&amp;c=0&amp;v=">http://www.emolecules.com/cgi-bin/search?t=ss&amp;q=409-21-2&amp;c=0&amp;v=</a> )
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### Properties

Molecular formula	SiC
Molar mass	40.097 g/mol
Appearance	black-green odorless powder
Density	3.22 g/cm <sup>3</sup> , solid
Melting point	2730°C
Solubility in water	insoluble <sup>0</sup>

### Hazards

EU classification	not listed
NFPA 704	

Except where noted otherwise, data are given for materials in their standard state (at 25 °C, 100 kPa)  
 Infobox disclaimer and references

The material formed in the Acheson furnace varies in purity, according to its distance from the graphite resistor heat source. Clear, pale yellow and green crystals have the highest purity and are found closest to the resistor. The color changes to blue and black at greater distance from the resistor, and these darker crystals are less pure and usually doped with nitrogen, which increases the electrical conductivity of these samples, and with aluminium and/or iron, which decrease conductivity.

Purer silicon carbide can be made by the more expensive process of chemical vapor deposition (CVD). Commercial large single crystal silicon carbide is grown using a physical vapor transport method commonly known as modified Lely method.

Purer silicon carbide can also be prepared by the thermal decomposition of a polymer, poly(methylsilylene), under an inert atmosphere at low temperatures. Relative to the CVD process, the pyrolysis method is advantageous because the polymer can be formed into various shapes prior to thermalization into the ceramic.

## Discovery

The material was manufactured by Edward Goodrich Acheson around 1893, and he not only developed the electric batch furnace by which SiC is still made today but also formed The Carborundum Company to manufacture it in bulk, initially for use as an abrasive. In 1900 the company settled with the Electric Smelting and Aluminum Company when a judges' decision gave "priority broadly" to its founders "for reducing ores and other substances by the incandescent method".<sup>[1]</sup> It is said that Acheson was trying to dissolve carbon in molten corundum (alumina) and discovered the presence of hard, blue-black crystals which he believed to be a compound of carbon and corundum: hence carborundum. Or, he named the material "carborundum" by analogy to corundum, which is another very hard substance (9 on the Mohs scale).



Silicon carbide single crystal from one of the Minatoc laboratories

## In nature

Naturally occurring **moissanite** is found only in minute quantities in certain types of meteorite and in corundum deposits and kimberlite. Virtually all of the silicon carbide sold in the world, including moissanite jewels, is synthetic. Natural moissanite was first found in 1893 as a small component of the Canyon Diablo meteorite in Arizona by Dr. Ferdinand Henri Moissan, after whom the material was named in 1905. Moissan's discovery of naturally occurring SiC was initially disputed because his sample may have been contaminated by silicon carbide saw blades that were already on the market at that time.

Analysis of SiC grains found in the Murchison carbonaceous chondrite meteorite has revealed anomalous isotopic ratios of carbon and silicon, indicating an origin from outside the solar system and closer to the galactic centre.<sup>[2]</sup>

## Properties

Silicon carbide exists in at least 70 crystalline forms. Alpha silicon carbide ( $\alpha$ -SiC) is the most commonly encountered polymorph; it is formed at temperatures greater than 2000 °C and has a hexagonal crystal structure (similar to Wurtzite). The beta modification ( $\beta$ -SiC), with a face-centered cubic crystal structure (similar to diamond and zincblende or sphalerite), is formed at temperatures below 2000 °C and is shown in the structure at the top of the page. Until recently, the beta form has had relatively few commercial uses, although there is now increasing interest in its use

as a support for heterogeneous catalysts, owing to its higher surface area compared to the alpha form.

Silicon carbide has a specific gravity of 3.2, and its high sublimation temperature (approximately 2700 °C) makes it useful for bearings and furnace parts. Silicon carbide does not melt at any known pressure. It is also highly inert chemically. There is currently much interest in its use as a semiconductor material in electronics, where its high thermal conductivity, high electric field breakdown strength and high maximum current density make it more promising than silicon for high-powered devices.<sup>[3]</sup> In addition, it has strong coupling to microwave radiation, which together with its high melting point, permits practical use in heating and casting metals. SiC also has a very low coefficient of thermal expansion and experiences no phase transitions that would cause discontinuities in thermal expansion.

Pure SiC is clear. The brown to black color of industrial product results from iron impurities. The rainbow-like lustre of the crystals is caused by a passivation layer of silicon dioxide that forms on the surface.

## Uses

### Semiconductor

Pure  $\alpha$ -SiC is an intrinsic semiconductor with band gaps of 3.28 eV (4H) and 3.03 eV (6H) respectively.

Possibly the earliest electrical application of SiC was in lightning arresters in electric power systems. These devices must exhibit high resistance until the voltage across them reaches a certain threshold  $V_T$ , at which point their resistance must drop to a lower level and maintain this until the applied voltage drops below  $V_T$ .

It was recognized early on that SiC had such a voltage-dependent resistance, and so columns of SiC pellets were connected between high-voltage power lines and the earth. When a lightning strike to the line raises the line voltage sufficiently, the SiC column will conduct, allowing the worst of the stroke to pass harmlessly to the earth instead of along the power line. Unfortunately, such SiC columns proved to conduct significantly at normal power-line operating voltages and thus had to be placed in series with a spark gap. This spark gap is ionized and rendered conductive when lightning raises the voltage of the power line conductor, thus effectively connecting the SiC column between the power conductor and the earth, where it then operates as before.

The trouble here is that spark gaps used in lightning arrestors are notoriously unreliable: they either fail to strike an arc when needed or fail to turn off afterwards: this last is due to material failure or contamination by dust or salt. In fact, the whole idea of using the SiC column was to eliminate the need for the spark gap in a lightning arrester.

But with some intensive engineering, the gapped SiC lightning arrester proved to be a reasonably good lightning-protection tool for many years. There were several brand names; GE and Westinghouse made them, among others. The gapped SiC arrester has been largely displaced by no-gap varistors that use columns of zinc oxide pellets.

Silicon carbide is used for blue LEDs, ultrafast, high-voltage Schottky diodes, MOSFETs and high temperature thyristors for high power switching. A famous paper by Jayan Baliga<sup>[4]</sup> shows enormous potential of SiC as a power device material. However, some problems with the interface of SiC with silicon dioxide has hampered the development of SiC based power MOSFET and IGBTs. Extensive research is going on to solve the problem. Due to its high thermal conductivity, SiC is also used as substrate for other semiconductor materials such as gallium nitride.<sup>[5]</sup> Due to its wide band gap, SiC-based parts are capable of operating at high temperature (over 350 °C), which together with good thermal conductivity of SiC reduces problems with cooling of power parts. They also possess increased tolerance to radiation damage, making it a material desired for defense and aerospace applications. Its main competitor is gallium nitride. Although diamond has an even higher band gap, SiC-based devices are easier to manufacture due to the fact

that it is more convenient to grow an insulating layer of silicon dioxide on the surface of a silicon carbide wafer than it is with diamond.

Pure SiC is a poor electrical conductor. Addition of suitable dopants significantly enhances its conductivity. Typically, such material has a negative temperature coefficient between room temperature and about 900 °C, and positive temperature coefficient at higher temperatures, making it suitable material for high temperature heating elements.

Silicon carbide is also used as an ultraviolet detector. Nikola Tesla, around the turn of the 20th century, performed a variety of experiments with carborundum. Electroluminescence of silicon carbide was observed by Captain Henry Joseph Round in 1907 and by O. V. Losev in the Soviet Union in 1923.<sup>[6]</sup>

### **Structural material**

In the 1980s and 1990s, silicon carbide was studied on several research programs for high-temperature gas turbines in the United States, Japan, and Europe. The components were intended to replace nickel superalloy turbine blades or nozzle vanes. However, none of these projects resulted in a production quantity, mainly because of its low impact resistance and its low fracture toughness.

### **Astronomy**

Silicon carbide's hardness and rigidity make it a desirable mirror material for astronomical work, although its properties also make manufacturing and designing such mirrors quite difficult.

Silicon carbide may be a major component of the mantles of as-yet hypothetical carbon planets.

### **Grit**

Silicon carbide is a popular product in modern lapidary due to the durability and low cost of the material. It is also used in coarse to fine grit sandpapers and as a grip tape in skateboards.

### **Disc brake**

Silicon-infiltrated carbon-carbon composite is used for high performance brake discs as it is able to withstand extreme temperatures. The silicon reacts with the graphite in the carbon-carbon composite to become silicon carbide. These discs are used on some sports cars, including the Porsche Carrera GT.

### **Clutch**

The Porsche Carrera GT has two plates made of silicon carbide as well.

### **Diesel particulate filter**

Silicon carbide is used in a sintered form for diesel particulate filters.

### **Thin filament pyrometry**

Silicon carbide fibers are used to measure gas temperatures in a diagnostic technique called thin filament pyrometry.



## Ceramic membrane

Silicon carbide is used for producing ceramic membranes for industrial processes, yielding high fluxes due to the sintering process.

## Cutting tools

In 1982 at the Oak Ridge National Laboratories, George Wei, Terry Tiegs, and Paul Becher discovered a composite of aluminium oxide and silicon carbide whiskers. This material proved to be exceptionally strong. Development of this laboratory-produced composite to a commercial product took only three years. In 1985, the first commercial cutting tools made from this alumina and silicon carbide whisker-reinforced composite were introduced by the Advanced Composite Materials Corporation (ACMC) and Greenleaf Corporation.

## Heating element

References to silicon carbide heating elements exist from the early 20th century when they were produced by Acheson's Carborundum Co. in the U.S. and EKL in Berlin. Silicon carbide offered increased operating temperatures compared with metallic heaters, although the operating temperature was limited initially by the water-cooled terminals, which brought the electric current to the silicon carbide hot zone. The terminals were not attached to the hot zone, but were held in place by weights, or springs. Operating temperature and efficiency was later increased by the use of separate low resistance silicon carbide "cold ends", usually of a larger diameter than the hot zone, but still held in place only by mechanical pressure. The development of reaction-bonding techniques led to the introduction of jointed elements. Initially, these featured larger diameter cold ends, but by the 1940s, equal diameter elements were being produced. From the 1960s onwards, one-piece elements were produced, with cold ends created by filling the pore volume with a silicon alloy. Another one-piece technique is to cut a spiral slot in a homogeneous tube where the hot section is desired. Further developments have included the production of multi-leg elements, where two or more legs are joined to a common bridge, and the production of high density, reaction-bonded elements, which provide additional resistance to oxidation and chemical attack. Silicon carbide elements are used today in the melting of non-ferrous metals and glasses, heat treatment of metals, float glass production, production of ceramics and electronics components, etc.

## Nuclear Fuel

Silicon carbide is often used as a layer of the TRISO coating for the nuclear fuel elements of high temperature gas cooled reactors or very high temperature reactors such as the Pebble Bed Reactor.

## Jewel

As a jewel used in jewelry, silicon carbide is called **Moissanite** for the jewel's discoverer Dr. Henri Moissan<sup>[7]</sup>. Moissanite is somewhat similar to diamond in several important respects: it is transparent and hard (9, although a patent states 8.5-9.0,<sup>[8] -note</sup> on the Mohs scale compared to 10 for diamond), with a refractive index between 2.65 and 2.69 (compared to 2.42 for diamond). Moissanite is somewhat harder than common cubic zirconia. Unlike diamond, Moissanite is strongly birefringent. This quality is desirable in some optical applications, but not in gemstones. For this reason, Moissanite jewels are cut along the optic axis of the crystal to minimize birefringent effects. It is lighter (density 3.22 vs. 3.56), and much more resistant to heat. This results in a stone of higher lustre, sharper facets and good resilience. Loose moissanite stones may be placed directly into ring moulds; unlike diamond, which burns at 800 °C,

moissanite remains undamaged by temperatures up to twice the 900 °C melting point of 18k gold.

In 1998, Charles & Colvard introduced jewel-quality synthetic silicon carbide to the market under the name "moissanite". This gemstone possesses superior fire and brilliance to diamonds. Upon introduction, some jewelers misidentified moissanite as diamond. Moissanite's thermal conductivity is very close to that of diamond, rendering useless the older thermal testers that they relied upon. Moissanite has a slightly higher index of refraction (brilliance) and much greater dispersion (fire) than diamond, as it shows many more "flashes" of color than a diamond. Unlike cubic zirconia and other diamond simulants, moissanite does not cloud over time, and is extremely durable.

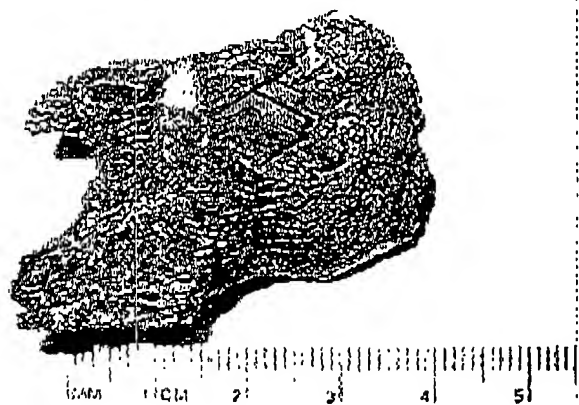
Once its properties are known, moissanite is easy to distinguish from diamond, as it is doubly refractive and has a very slight green, yellow, or gray fluorescence under ultraviolet light. Because the brilliance of the moissanite helps to cancel the perceived color, cuts with higher brilliance tend to have a much "whiter appearance" (i.e., round brilliant, square brilliant, and cushion cut) versus cuts that have a lower refractive index such as the marquise, radiant and especially the pear-shaped cut. The color is often defined as "near colorless" which on the diamond color scale ranges from G through J.

Charles & Colvard markets moissanite primarily to self-purchasing women. However, moissanite engagement rings, eternity bands and circle pendants have become popular among value-conscious consumers. For example, a 1-carat (200 mg) moissanite gem sells for about \$500 (2007 USD), while a diamond of similar size and color typically sells for \$4500 or more. Moissanite jewelry is sold at a wide variety of internet and retail outlets.

## Steel

Silicon carbide dissolved in a basic oxygen furnace used for making steel acts as a fuel and provides energy which increases the scrap to hot metal ratio.<sup>[9]</sup> It can also be used to raise tap temperatures and adjust the carbon content.

90% silicon carbide is used by the steel industry as a ladle deoxidizer, a source of silicon and carbon in the ladle, an electric furnace slag deoxidizer, and as a synthetic slag additive.<sup>[10]</sup> According to Miller and Company,<sup>[11]</sup> it costs less than ferrosilicon and carbon combination, produces cleaner steel due to low level of trace elements, it has a low gas content, it does not lower the temperature of steel, and it has an abundant world wide supply. The silicon carbide used as a steel additive or fuel comes as a granular product in either bulk and bags.



Piece of silicon carbide used in steel making

50% and 65% silicon carbide are used in the steel industry for processing steel and iron scrap. Typically supplied as blocks and made from silicon carbide crucible scrap, it helps extend the hot metal supply and raises the tap temperature.<sup>[12]</sup> The blocks are typically made using an automated concrete block making machine, and utilize water and limestone cement as a binder.

## Armour

Like some other hard ceramics (namely alumina and boron carbide), silicon carbide is used in composite armour (eg. Chobham armour), and in ceramic plates in bulletproof vests.

## Catalyst Support

The natural resistance to oxidation exhibited by silicon carbide, as well as the discovery of new ways to synthesize the higher surface area beta form, has led to significant interest in its use as a heterogeneous catalyst support. The beta cubic form has already been employed for several years as a catalyst support for the oxidation of C4 hydrocarbons, such as n-butane, to maleic anhydride.

## In popular culture

- In Edgar Rice Burroughs' Barsoom series, "carborundum" is used as building material for city walls.
- In 2001: A Space Odyssey and the related series of books and movies (by Arthur C. Clarke and Stanley Kubrick, among others) the monoliths (or at least their exteriors) were made of silicon carbide
- In the *Discworld* novel *Monstrous Regiment*: Carborundum is the name of the Troll that enlists.
- In the movie *Snatch*, a pawn shop employee (Sol) determines a diamond is actually Moissanite, much to the dismay of the thief (Bad Boy Lincoln) who stole the ring.
- The name of the material is part of the pun "Illegitimi non carborundum" (Dog Latin for "don't let the bastards grind you down"), which figures into a football fight song of Harvard University among other things.
- In the BBC television show *Top Gear*, host Jeremy Clarkson expresses excitement over the mere mention of silicon carbide used in the brakes and clutch of the Porsche Carrera GT.
- Silicon carbide is the material used for the National Design Awards trophy, awarded by the Cooper-Hewitt National Design Museum designed by William Drenttel and Jessica Helfand and manufactured by Norton Electronics.

## Patents and trademarks

Edward Goodrich Acheson (1856–1931) patented the method for making silicon carbide powder on February 28, 1893. On May 19, 1896, he was also issued a patent for an electrical furnace used to produce silicon carbide.<sup>[13]</sup> Carborundum is a trademark of Saint-Gobain Abrasives.

## See also

- Diamond simulant.
- Illegitimi non carborundum, mock-Latin using the trademark Carborundum as if it were a Latin verb gerund.

## References

1. ^ Mabery, Charles F. (1900). "Notes, On Carborundum (<http://books.google.com/books?id=BJDAAAAYAAJ&pg=PA706>)". *Journal of the American Chemical Society* **XXII** (Part II): 706-707. Johnson Reprint Company, via Google Books scan of Harvard University copy. Retrieved on 2007-10-28.
2. ^ <http://img.chem.ucl.ac.uk/www/kelly/history.htm>
3. ^ [http://www.mdatechnology.net/techsearch.asp?articleid=174\[1\]](http://www.mdatechnology.net/techsearch.asp?articleid=174[1]) (<http://www.mdatechnology.net/techsearch.asp?articleid=174>)
4. ^ Comparison of 6H-SiC, 3C-SiC, and Si for power devices, Bhatnagar, M., Baliga, B.J., IEEE Transactions on Electron Devices, March 1993
5. ^ [http://www.qinetiq.com/home/commercial/information\\_communication\\_and\\_electronics/Electronics/optonics/quantum\\_elect](http://www.qinetiq.com/home/commercial/information_communication_and_electronics/Electronics/optonics/quantum_elect)
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7. ^ Moissanite Education (<http://shopping.schubachstore.com/site/hosted-MOISSANITE-EDUCATION.htm>)

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9. ^ [http://www.millerandco.com/products/briquettes\\_steel/](http://www.millerandco.com/products/briquettes_steel/)
10. ^ [http://www.millerandco.com/products/briquettes\\_steel/specifications/briq90.htm](http://www.millerandco.com/products/briquettes_steel/specifications/briq90.htm)
11. ^ Miller and Company (<http://www.millerandco.com/>)
12. ^ [http://www.millerandco.com/products/briquettes\\_steel/specifications/briq65.htm](http://www.millerandco.com/products/briquettes_steel/specifications/briq65.htm)
13. ^ U.S. Patent 492,767 (<http://patft.uspto.gov/netaacgi/nph-Parser?patentnumber=492767>) – *Production of artificial crystalline carbonaceous material*

## References

^ Most in the jewelry industry may not recognize the 1/4 fractional intervals on the Mohs scale (a relative scale), and it is technically not correct since the Mohs scale only contains whole and half numbers. But the issuers of the patent use it in showing exactly where certain minerals are in relation to each other. On the original Mohs scale diamond was listed as a 10 and sapphire is listed as a 9. On an absolute scale, a diamonds hardness is between 5700–10400 on the Knoop scale, while a sapphire's hardness is 2000. The Knoop hardness of moissanite is 3000. This puts the Mohs hardness of moissanite around 8.5–9.25—as stated here, 9 1/4 may not be recognized, but 8.5–9.25 is the number used in the patents.

## External links

- Moissanite Buyer's Guide (<http://www.moissanite-buyers-guide.com/>) How to buy moissanite jewelry.
- A Brief History of Silicon Carbide (<http://img.chem.ucl.ac.uk/www/kelly/moissanite.htm>) Dr J F Kelly, University of London
- Material Safety Data Sheet ([http://physchem.ox.ac.uk/MSDS/SI/silicon\\_carbide.html](http://physchem.ox.ac.uk/MSDS/SI/silicon_carbide.html)) for Silicon Carbide
- Mindat.org (<http://www.mindat.org/min-2743.html>)
- discovery of Moissanite by Moissan ([http://www.farlang.com/gemstones/us-geol-survey-1905/page\\_040](http://www.farlang.com/gemstones/us-geol-survey-1905/page_040)) Moissan studied Meteorites. George Frederick Kunz describes this discovery in USGS annual report.

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Categories: Carbides | Silicon compounds | Semiconductor materials | Superhard materials | Ceramic materials | Refractory materials | Gemstones | Synthetic minerals | Deoxidizers

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